

Forest Biomass: *Wildfire, Ecosystem Services and Net Benefits of Bioenergy*

Biomass to Energy



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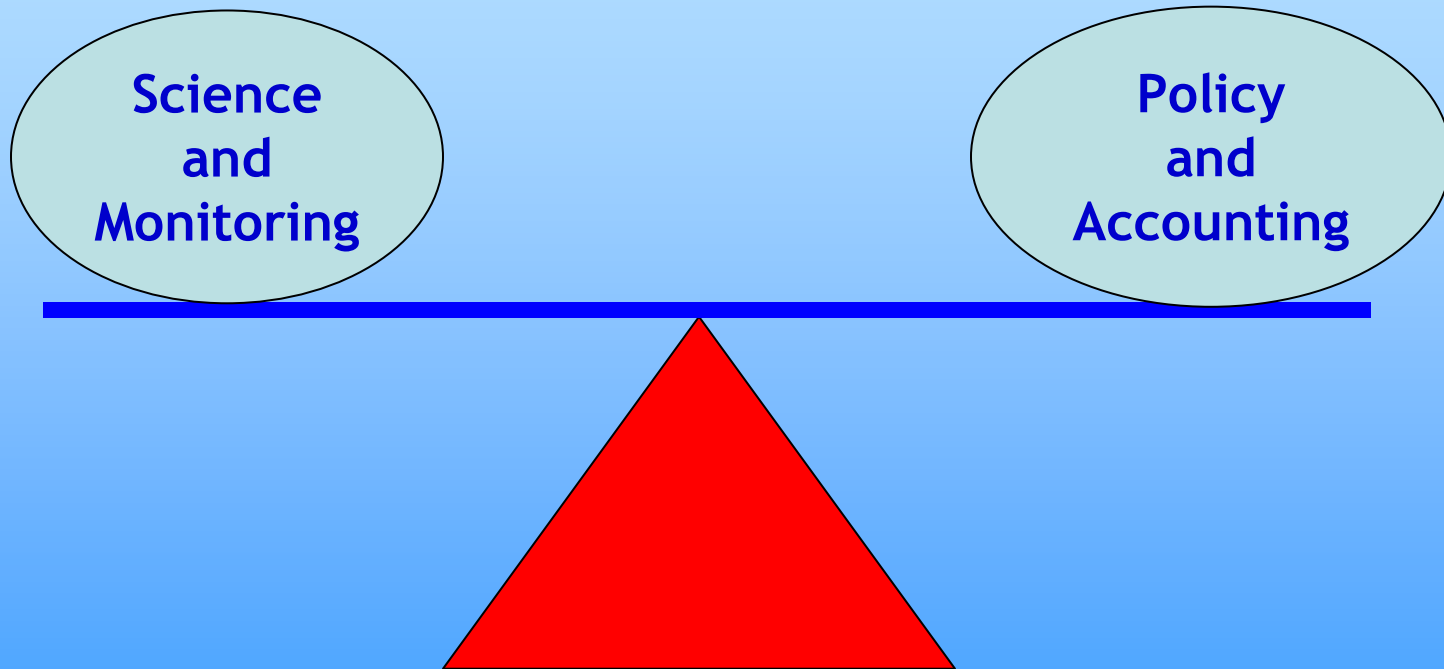
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Benefits of Bioenergy: What's in the balance?



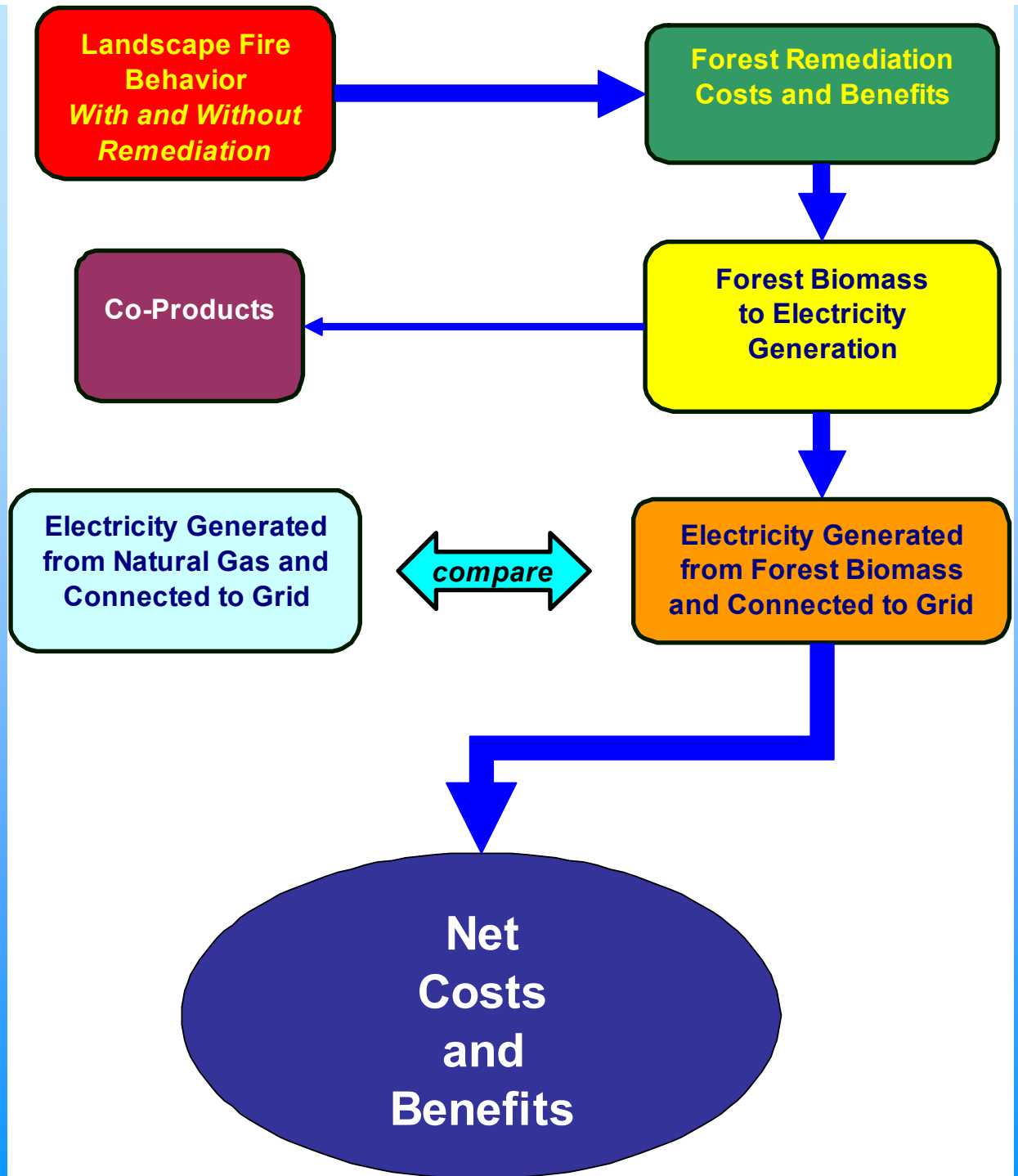
Biomass to Energy Project (B2E)



1. Model LIFE CYCLE environmental & economic values of using forest biomass for energy production
2. Test effects of different forest management scenarios on wildfire behavior, total emissions and other environmental factors
3. Develop a decision-support framework to test policy scenarios

Biomass to Energy

Basic Outline of B2E Model



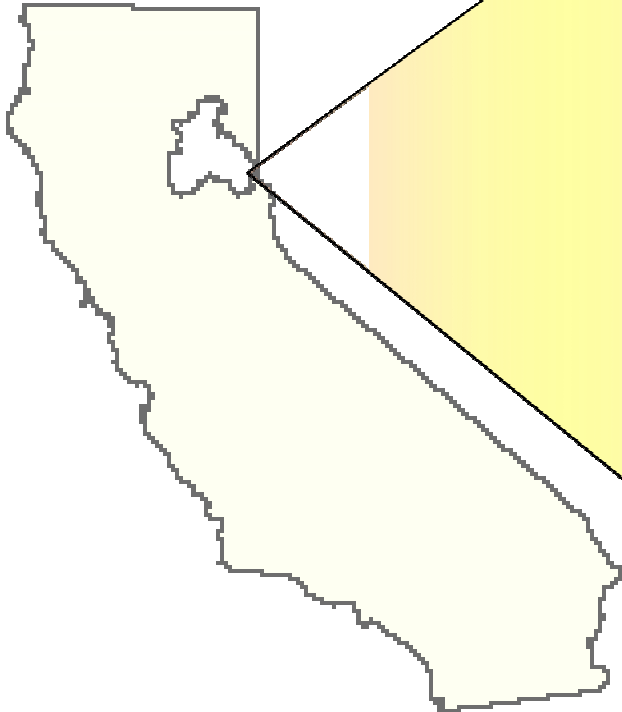
B2E Approach



1. Used *actual* landscapes and land uses, mapped to a real region
2. Used *actual* data from biomass power plants, operations and professional experience
3. Built a REFERENCE CASE and a TEST SCENARIO based on real-time practices
4. Delivered a modeling framework for further scenario development

B2E Test Landscape

Location of Beta 6 in California



- 2.7 million acres
- Approx. 3% of California's land area

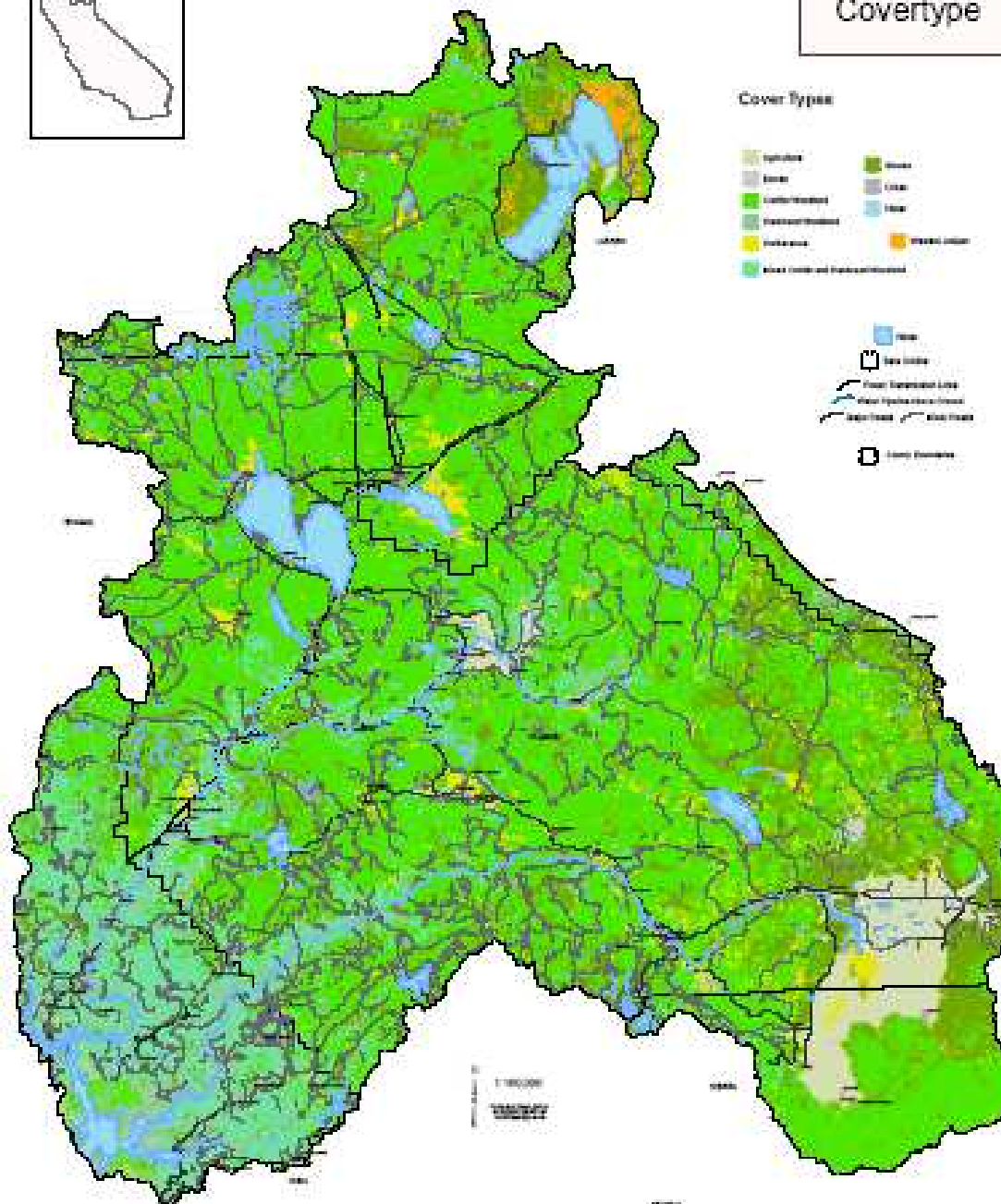
Modeling Domains

1. Vegetation - structure, changes from fire/treatment effects over 10-yr time frames
2. Fire - Using state of the art fire modeling
3. Equipment configuration - forest operation and transport
4. Life Cycle Assessment - energy and material inputs/outputs starting with forest treatments, operations, interconnection with the grid
 - Assess impacts & compare to those from energy produced by Natural Gas and California Energy Portfolio
5. Economics - costs/revenues of forest management and biomass conversion
6. Ecosystem Services - framework to consider non-market values of ecosystem services
7. Wildlife Habitat - Veg conditions from treatments - used to assess impacts on biological indicators
8. Watershed - effects on soil erosion on aquatic systems and key aquatic indicators
9. Forest Landscape Carbon - total fate of carbon in forest ecosystem



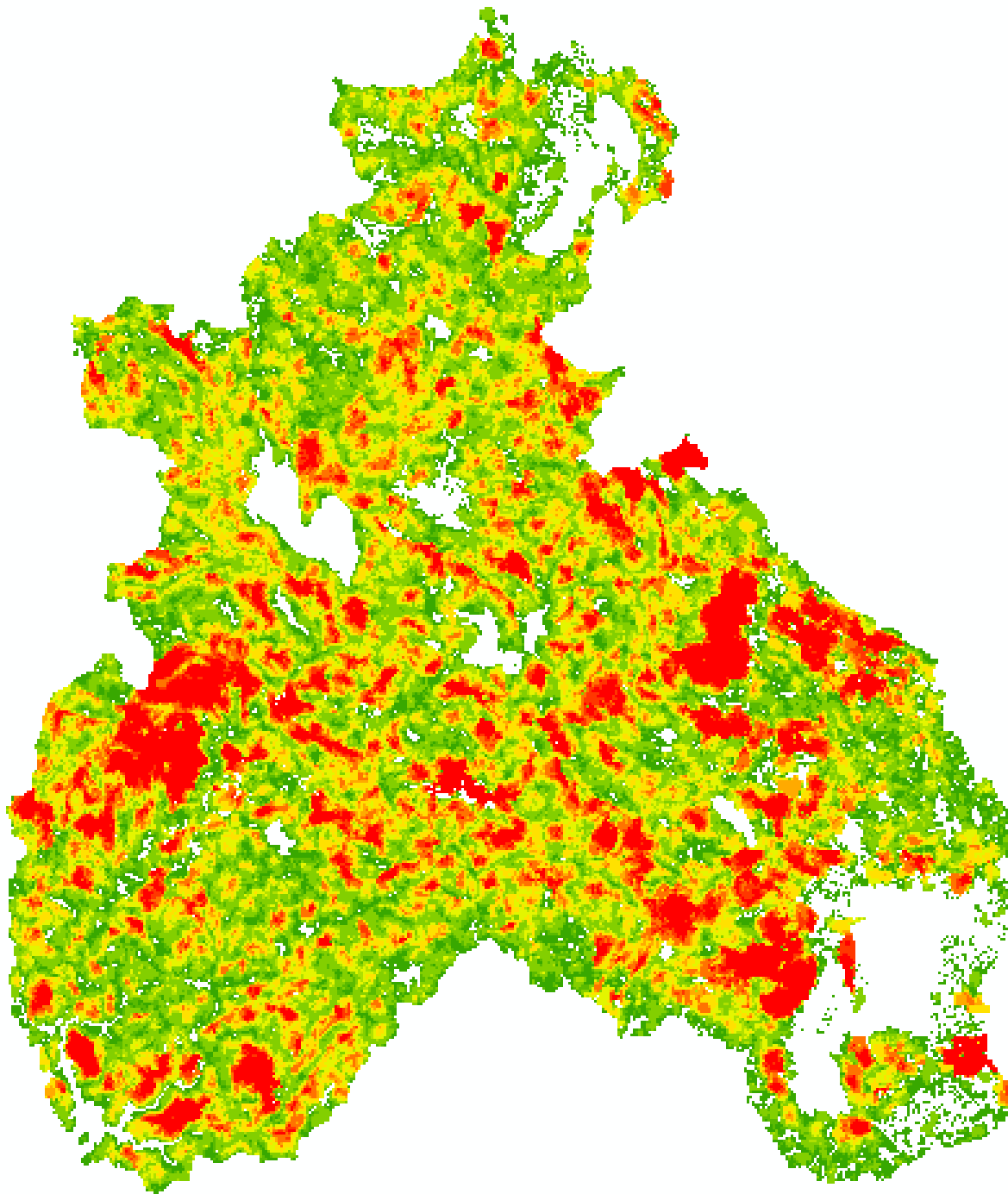
Beta 6 Covertype

Cover Types



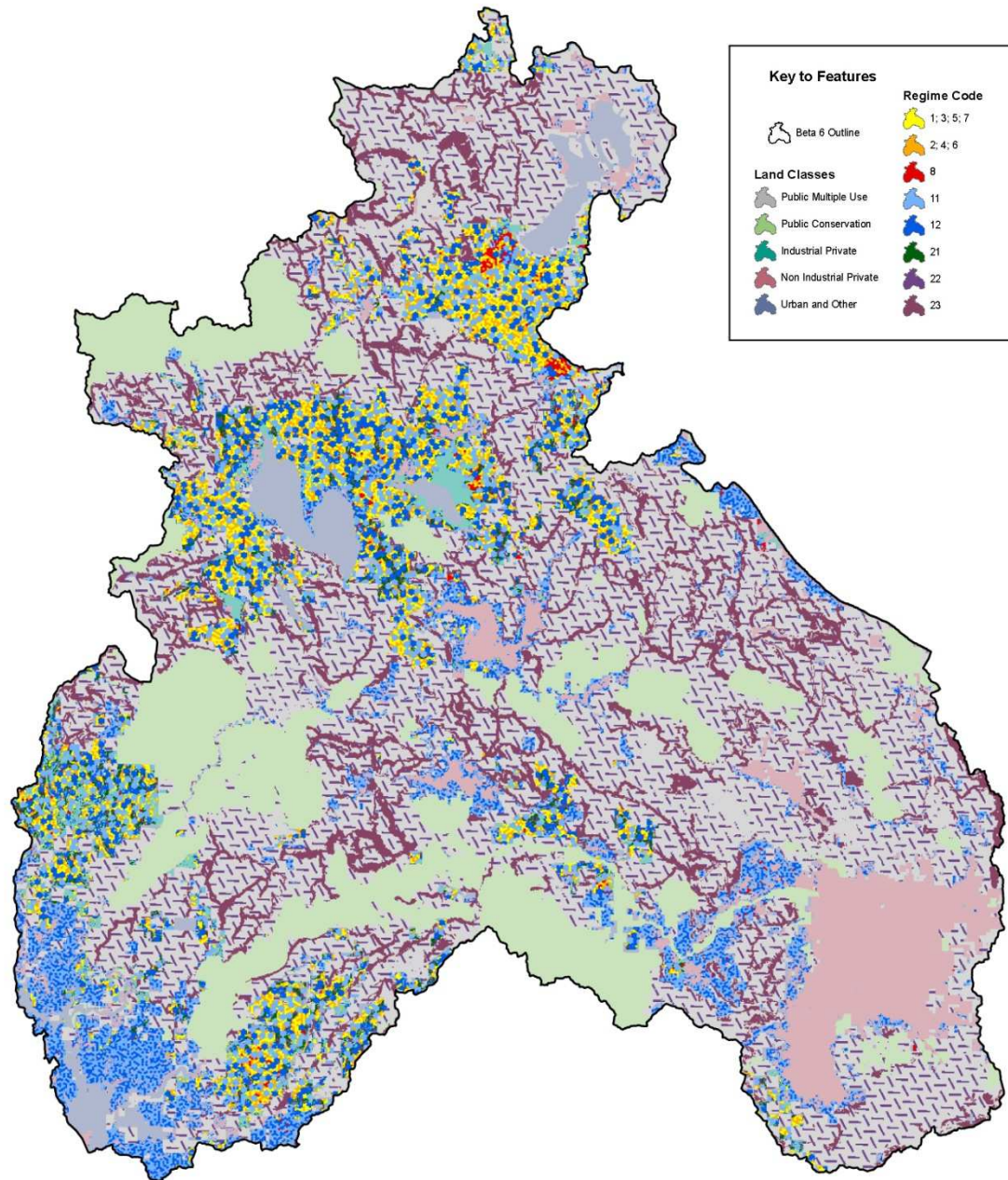
Vegetation Mapping

- 2.7 million acres - Very high diversity of vegetation, infrastructure and human uses
- 82 Veg types based on >450 Forest Inventory and Analysis (FIA) inventory plots in the actual study area
- Extrapolated plots to >2,200 individual polygons with GIS analysis



Burn Probabilities

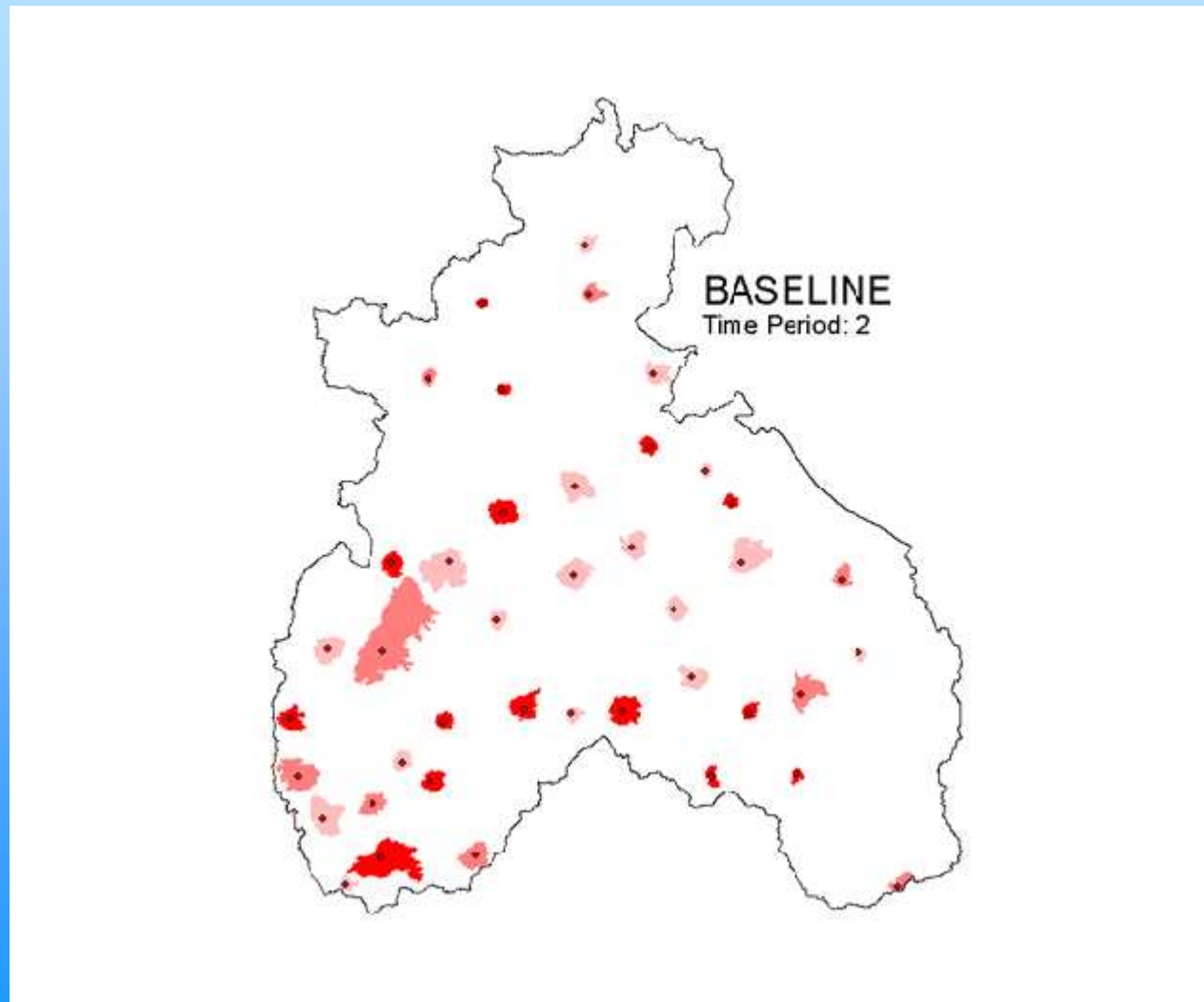
- 60 years of fire history data
- FLAMMAP analysis to establish hazard and risk
- Randomized ignitions across risk surface
- Select “representative ignition points” (RIPs) and fire-size class for each decade



Treatment Scenarios

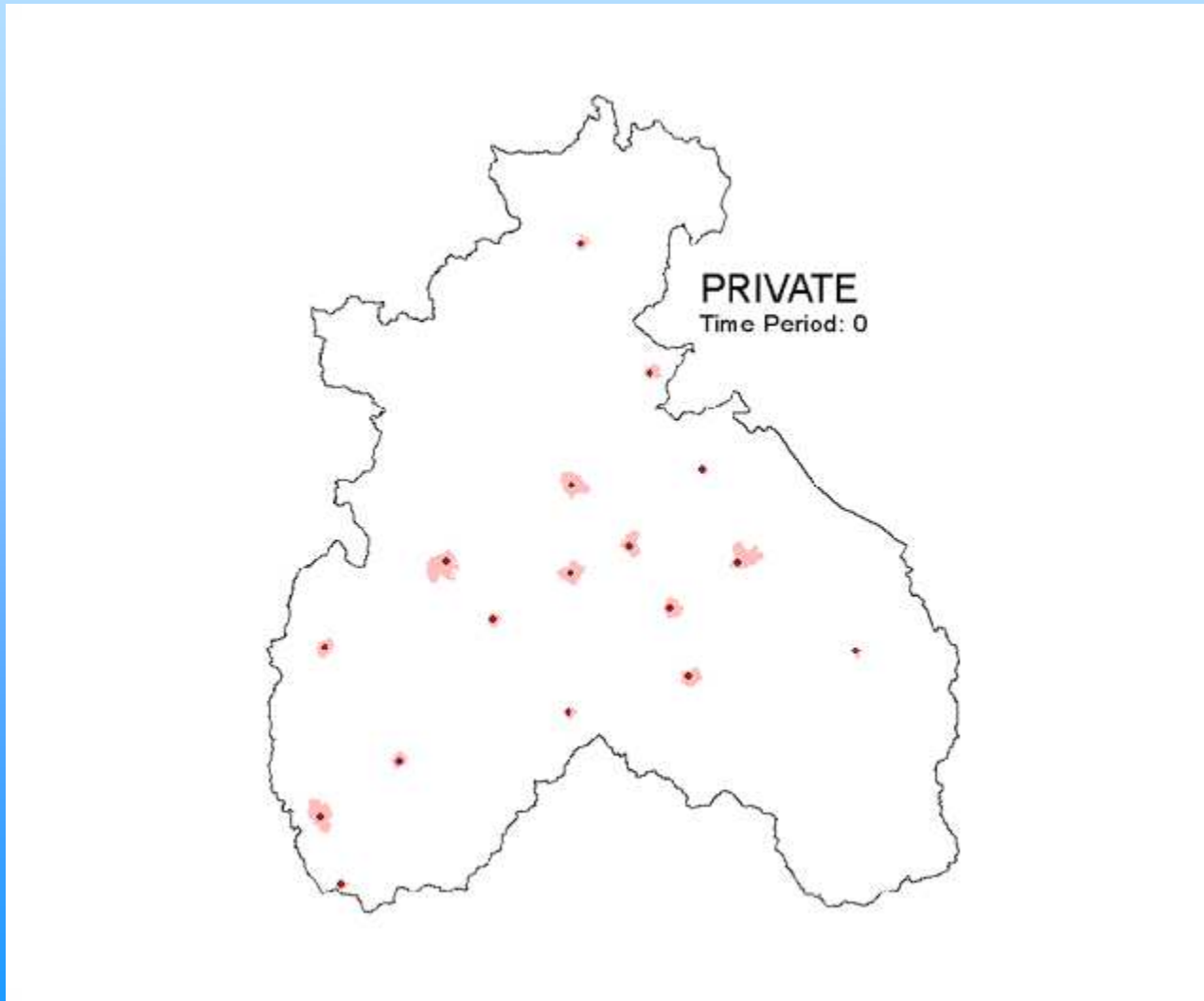
- 13 different treatment prescriptions
- Treatments applied at beginning of each decade (x 4 decades)
- Equipment and operations calculated for LCA
- Effects of treatments modeled

Baseline *without* Management

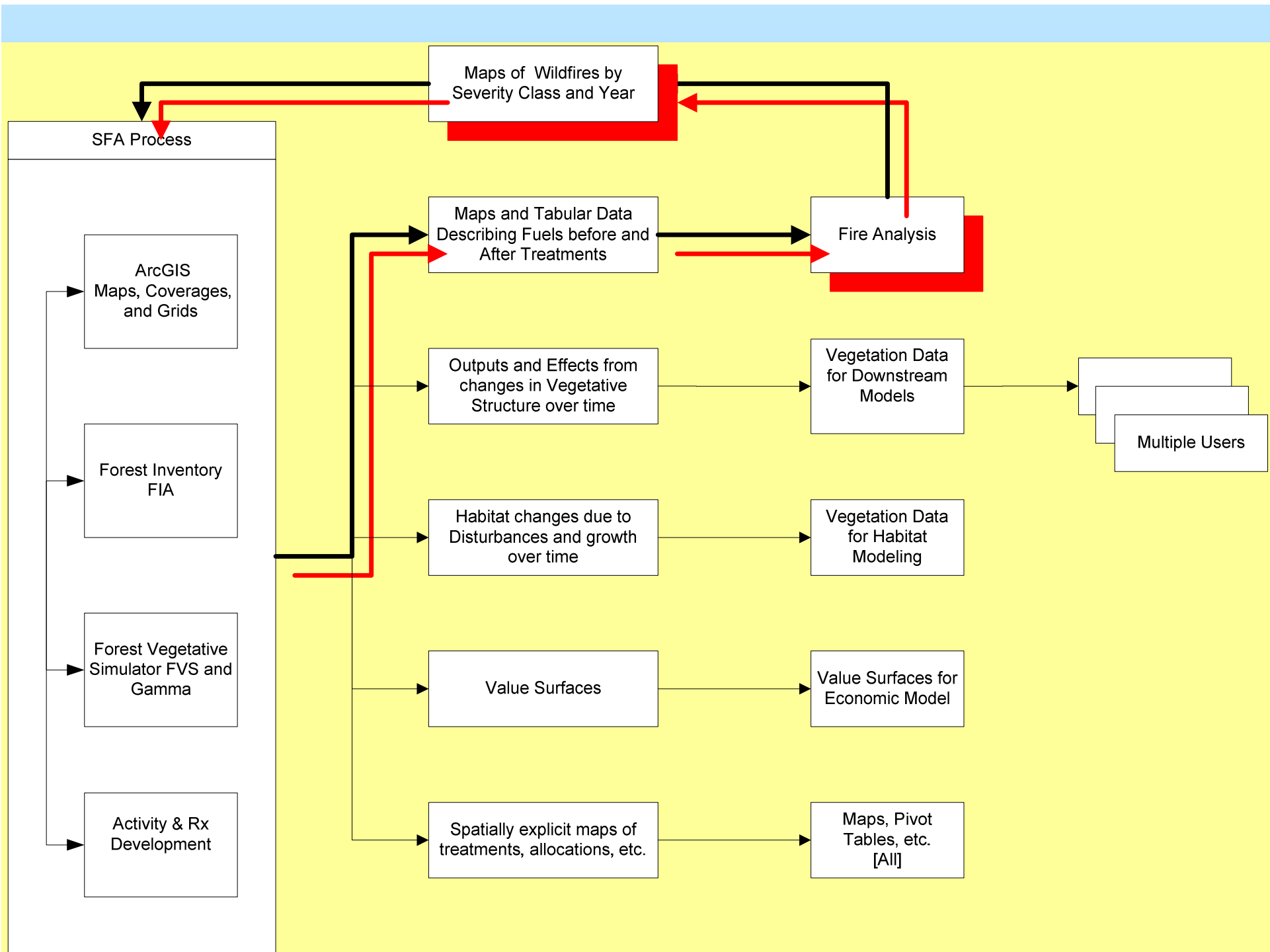


Note: this is an animated picture showing growth of wildfire perimeters during each decade. A printed version will not display the modeled wildfires.

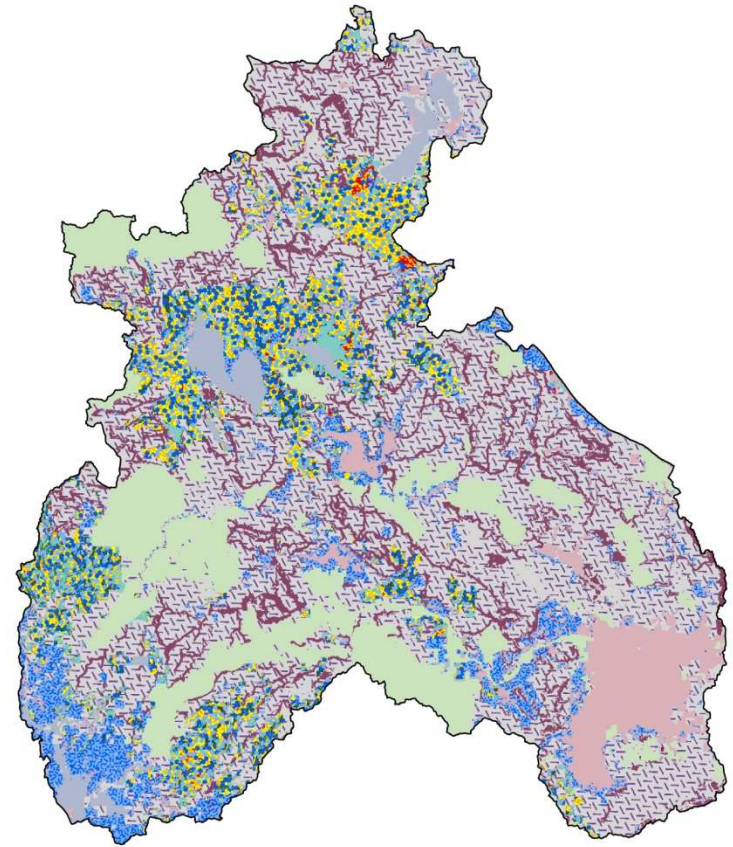
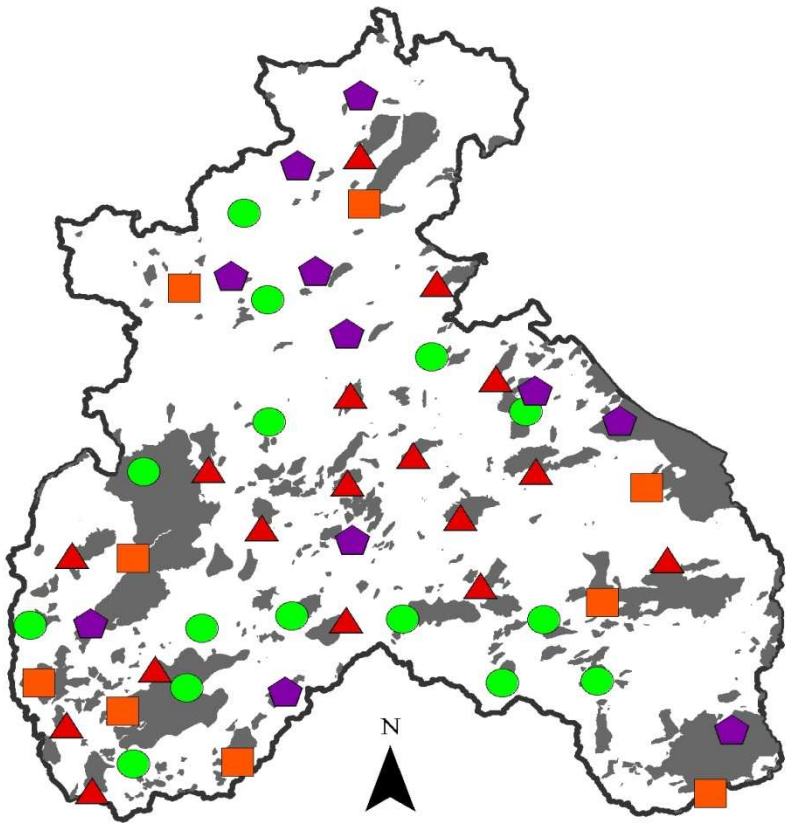
Test *with* Management



Note: this is an animated picture showing growth of wildfire perimeters during each decade. A printed version will not display the modeled wildfires.



The Basic Equation:



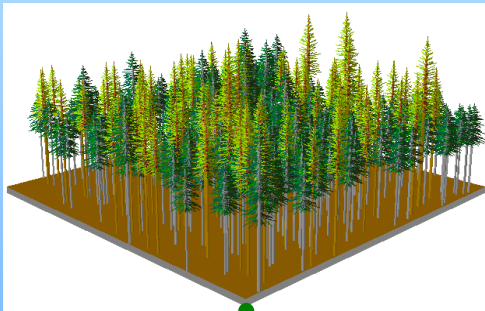
= Δ *wildfire, emissions, habitat, economics, watersheds, GHGs, etc.*

Reference Case vs. Test Scenario

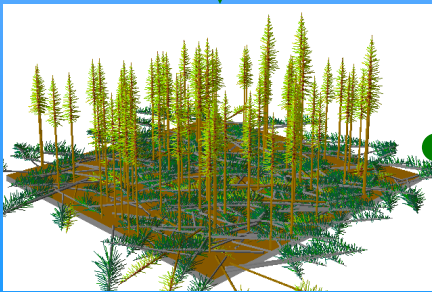
- 22% reduction in the extent of wildfire and significant reductions in fire severity
- 65% reduction in greenhouse gases (from 17 to 5.9 million tons CO₂ equivalent)
- \$246 million savings in wildfire damage
- \$4.6 million reduction in fire fighting costs
- Significant differences in watershed impacts
- No significant change in habitat quality from treatments
- Life-cycle “savings” of 120 Terawatt-hours in fossil fuel generation by using biomass for power
- 19 GWh produced from biomass power, using equivalent of .24 GWh of fossil fuels
- \$1.58 billion in power generation revenues
- Biomass fuel costs \$68/BDT based on treatment & transportation costs
- Plant operators can only pay up to \$8.20/BDT to get acceptable rate of return

Data & Modeling Challenges

Veg. Inventory,
Growth and Fuel
Models



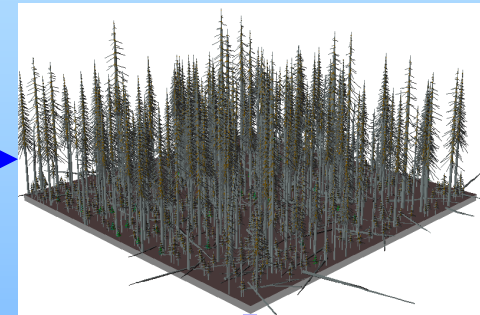
OR Thinned



Fire Behavior Models
(e.g., FARSITE, FOFEM,
FLAMMAP, etc.)



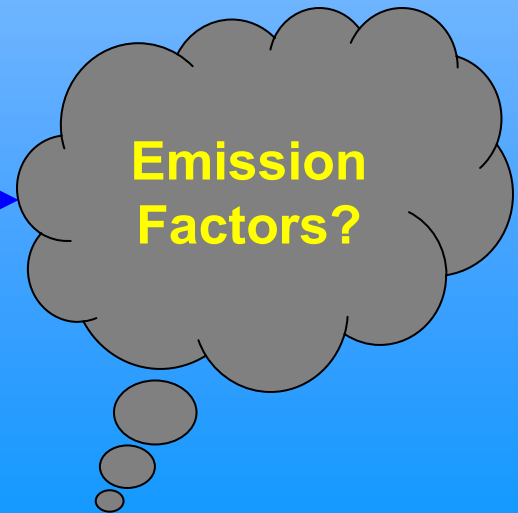
Severity
Classes?



FUEL MODELS?

Combustion
Efficiencies?

Emission
Factors?



Policy and Economics

- 70% land-based emission reductions in Waxman/Markey draft
- It's not FREE anymore....
- Reduction and mitigation markets must be REAL and VERIFIABLE
- What are we buying?

